REMARKS

Claims 1-9, 15-17 are active in this application, of which claims 1 and 15 are independent. By this amendment, claims 16 and 17 have been added and claims 5-9 have been amended to correct minor informalities therein. Support for the features recited in claims 16 and 17 can at least be found on page 9, lines 9-15 of Applicant's originally filed specification. Based on the following Remarks, Applicants respectfully request that the Examiner reconsider the outstanding rejection and they be withdrawn.

35 U.S.C. §103 Rejection

In the Office Action, claims 1-9 and 15 were rejected under 35 U.S.C. §103(a) for being unpatentable over U. S. Patent No. 5,180,690 issued to Czubatyj, *et al.* ("Czubatyj") in view of U. S. Patent No. 4,885,614 issued to Furukawa, *et al.* ("Furukawa"). This rejection is respectfully traversed.

The invention is directed to increasing dopant (e.g., carbon or boron) concentration in a silicon or silicon germanium film at a low processing temperature. Conventionally, "[a]lthough high levels of carbon doping have been desired in Si and SiGe to obtain requisite device characteristics", it was not possible to achieve increased dopant concentration at a low processing temperature because "conventional processes have not provided such high carbon levels, especially from SiGe films. When a germanium precursor source is started, the growth rate rapidly increases, providing too little time for introduction of desired dopants, such as carbon" (Specification, Page 2, Lines 12-17). The invention solves this problem by "reducing the partial pressure of the Si precursor, or, where Si and Ge precursors are used, of the Si and Ge precursors, reduction of film growth rate can be achieved. Such a reduction in the film growth rate permits increased dopant incorporation" (Specification, Page 6, Lines 24-27).

Claim 1 recites

> "A method of reducing film growth rate when growing a carbon or boron-doped silicon film or silicon germanium film, comprising: carbon or boron-doping while *supplying a silicon precursor* and optionally a germanium precursor to a substrate, *at reduced pressure of about 0.1 to 100 militorr*, at a temperature

> below about 800°C, wherein said step of doping while supplying includes supplying a dopant precursor from a single source to the substrate at a substantially constant flow rate while lowering a flow rate of the silicon precursor, whereby a concentration of the dopant in the substrate increases".

In the Office Action, the Examiner asserted that Czubatyj teaches carbon or boron-doping while *supplying a silicon precursor to a substrate*, particularly in column 11, line 16 and column 4, line 40.

In column 4, Czubatyj discloses

> "Typical dopant elements include phosphorous, boron, arsenic, aluminum, and combinations thereof. Typical precursor dopant gases include but are not limited to PH_3, PF_5, B_2H_6, BF_3, AsH_3, and combinations thereof" (column 4, lines 36-40).

However, "PH_3, PF_5, B_2H_6, BF_3, AsH_3 and combinations thereof" is disclosed as a silicon precursor to the substrate, and, hence, column 4 does not teach carbon or boron-doping *while supplying a silicon precursor* to a substrate.

In column 11, Czubatyj discloses an example of preparing doped polysilicon devices by low temperature process for the fabrication of the highly doped n+ type source and drain regions in thin film transistor devices.

Particularly in Example 1,

> "The amorphous silicon alloy film was deposited using silane (SiH_4) *as the deposition gas*" (column 11, lines 16).

It should be noted that silane was used as the deposition gas to deposit the amorphous silicon alloy film, *not as a precursor.*

Column 11 further describes

> "The reaction gas contains at least a precursor dopant gas and a diluent gas. The reaction gas employed herein comprises 98% hydrogen as the diluent gas, and 2% *phosphine* (PH_3) as *the precursor dopant gas*".

It is clear that PH_3 is used as a precursor dopant gas, and silane is not a precursor dopant gas. Accordingly, Czubatyj does not disclose or suggest "carbon or boron-doping while supplying a silicon precursor" for reducing film growth rate when growing a carbon or boron-doped silicon film.

The secondary reference to Furukawa is directed to a semiconductor device comprising a monocrystalline silicon or silicon-germanium alloy layer and a silicon-germanium-carbon alloy layer formed thereon, where two layers form a heterojunction therebetween.

Furukawa fails to cure the deficiency from the teachings of Czubatyj. Particularly, Furukawa is silent as to "carbon or boron-doping while *supplying a silicon precursor* and optionally a germanium precursor to a substrate ..." as claimed. Since none of the cited references teach or suggest this claimed feature, it would not have been obvious to combine the teachings of the cited references to arrive at the claimed invention.

Also, the Examiner asserts that Czubatyj teaches carbon or boron-doping *at reduced pressure of about 0.1 to 100 millitor* in column 11, line 23. Czubatyj describes, in column 11,

> "The polycrystalline silicon film devices where prepared by depositing an amorphous silicon alloy film onto low temperature Corning 7059 Glass substrate in a hot wall, low pressure chemical vapor deposition reactor maintained at approximately 2 torr, and 550° C. ... Specifically, the amorphous silicon alloy coated substrate was placed in an evacuable enclosure which enclosure was maintained at a pressure of 100 millitorr" (column 11, lines 10-23).

This descriptive portion is not directed to "carbon or boron-doping ... *at reduced pressure of about 0.1 to 100 militorr*" as claimed in claim 1. Thus, Czubatyj fails to disclose the claimed feature of "carbon or boron-doping while supplying a silicon precursor and optionally a germanium precursor to a substrate, *at reduced pressure of about 0.1 to 100 militorr.*

Furukawa fails to cure the deficiency from the teachings of Czubatyj. Particularly, Furukawa is silent as to "carbon or boron-doping while *supplying a silicon precursor* and optionally a germanium precursor to a substrate ..." as claimed. Since none of the cited reference teaches or suggest carbon or boron-doping at reduced pressure of about 0.1 to 100 militorr, the invention would not have been obviously derived from combining the teachings of the cited references.

Further, claim 1 recites

> "supplying a dopant precursor from a single source to the substrate at a substantially constant flow rate while lowering a flow rate of the silicon precursor"

The Examiner admitted "Czubatyj does not specifically disclose lowering the flow rate of the silicon precursor, whereby a concentration of the dopant in the substrate increases". Nevertheless, the Examiner has not pointed out where Furukawa discloses this missing feature from Czubatyj. Without proving that the cited references, either alone or in combinations teaches all the claimed features, it would be premature to arrive at the conclusion of a *prima facie* case of obviousness.

As mentioned above, it is submitted that claim 1 is patentable over Czubatyj and Furukawa. Claims 2-9 that are dependent from claim 1 would be also patentable at least for the same reason. Independent claim 15 would be also patentable since it includes the same features of claim 1. Accordingly, Applicants respectfully request that the rejection over claims 1-9 and 15 be withdrawn.

Added claims:

Applicants respectfully submit that added claims 16 and 17 are at least allowable for the reasons discussed above with regards to claims 1 and 15, from which claims 16 and 17 depend from, respectively. In addition, in the invention, both boron and carbon are incorporated simultaneously into silicon or silicon germanium. However, Applicants are of the opinion that the applied references do not teach how to incorporate two dopant species.

CONCLUSION

In view of the foregoing remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required.

Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 09-0458.

Respectfully submitted,

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